Docket No. AT9-99-469

METHOD AND APPARATUS FOR MAXIMIZING EFFICIENCY OF SMALL DISPLAY IN A DATA PROCESSING SYSTEM

BACKGROUND OF THE INVENTION

1. Technical Field:

The present invention relates generally to an improved data processing system and, in particular, to a method and apparatus for maximizing efficiency of a small display in a data processing system. Still more particularly, the present invention relates to a method and apparatus for displaying data and receiving input on a display in a data processing system.

2. Description of Related Art:

The manipulation of data in a computer is well known in the prior art. Data may be manipulated in many ways in a modern state of the art computer including: data accessing, data encoding, data communications, data compression, data conversion, data entry, data exchange, data filing, data linking, data locking, data mapping, data modeling, data processing, data recording, data sorting, and data transferring. The large amounts of data that are available to the user of a modern state of the art computer often become overwhelming in magnitude and complexity. In providing an interface between a user and a computer, the use of a graphical user interface (GUI) provides an intuitive and graphical interface between the user and a computer. A GUI is an interface system, by which a user interacts with a computer through windows or view ports, icons, menus, pointing devices,

etc.

Although the use of GUIs has made the manipulation of data easier for users in some instances, GUIs have created new problems especially in different types of computers. For example, pen-based or pen-aware computer systems are becoming more common place. These computer systems, also referred to as personal digital assistant or hand held computers, are often housed in a relatively flat enclosure in which the display assembly functions both as an input device and an output device. When operating as an input device, the display assembly senses the position of the tip of a stylus on the viewing screen and provides this positional information to the computer's central processing unit. Some display assemblies also are able to sense the pressure of the stylus on the screen to provide further information to the central processing unit. When operating as an output device, the display assembly presents computer generated images on the screen.

This dual function in pen-based computer system permits a user to operate the computer as a computerized notepad. As the computer senses the position and movement of the stylus, the computer generates a corresponding image on the screen to create the illusion that the stylus is drawing the image directly on the screen. With suitable recognition software, text and numeric information also can be entered into the pen-based computer in a similar fashion. Additionally, these types of computers also may provide a number of useful functions, such as serving as an address book, an appointment calendar, and a to do list.

These types of computer systems, however, have a

drawback when compared to more traditional computer systems, such as a personal desktop computer. One particular drawback is the size of the display. These displays are relatively small and can display only limited amounts of information. As a result, the amount of display space for displaying data and receiving user input is limited. If an input field is too small, a user will be unable to manipulate a stylus sufficiently to enter data. As a result, data entry may require traversing several screens or windows. By doing so, the logic or ease of use of an application may be reduced.

Therefore, it would be advantageous to have an improved method and apparatus for displaying data and receiving user input in a computer.

SUMMARY OF THE INVENTION

The present invention provides a method and apparatus in a data processing system for processing user input. A graphical widget is displayed on a display device within the data processing system, wherein the graphical widget is displayed using a first size. Responsive to receiving a selected user input, a display of the graphical widget is resized on the display device to a second size for receiving user input, wherein the second size is larger than the first size.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 is a diagram illustrating a computer in the form of a personal digital assistant depicted in which the processes of the present invention may be implemented;

Figure 2 is a block diagram of a personal digital assistant depicted in accordance with a preferred embodiment of the present invention;

Figure 3 is a pictorial representation depicting a data processing system in which the present invention may be implemented in accordance with a preferred embodiment of the present invention;

Figure 4 is a block diagram illustrating a data processing system in which the present invention may be implemented;

Figures 5A and **5B** are diagrams illustrating an example of a graphical widget depicted in accordance with a preferred embodiment of the present invention;

Figures 6A-6C are diagrams illustrating a graphical widget in the form of controls depicted in accordance with a preferred embodiment of the present invention; and

Figure 7 is a flowchart of a process for handling

input to a graphical widget depicted in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the figures and, in particular, with reference to **Figure 1**, a diagram illustrating a computer in the form of a personal digital assistant is depicted in which the processes of the present invention may be implemented. Computer **100** is an example of a personal digital assistant (PDA). PDA **100** in the depicted examples is a portable personal computer in which housing **102** includes a screen **104**. Screen **104** in this example is a touch responsive screen including a mechanism for selecting or designating a location on the surface of screen **104** in response to a pointer being placed on the surface of screen **104**. As used herein, a reference to a "pointer" may be to either a stylus or a graphical pointer manipulated by a pointing device, such as a mouse or trackball.

Essentially, screen **104** comprises data panels placed either on the display surface or between the user and the display surface. Additionally, PDA **100** also provides ports and connectors (not shown) for power and serial access to its system board. Additionally, PDA **100** also may include a mechanism to receive PC cards, such as a modem or flash memory, for additional functionality.

Turning now to **Figure 2**, a block diagram of a personal digital assistant is depicted in accordance with a preferred embodiment of the present invention. Personal digital assistant (PDA) **200** includes a processing unit **202**, a read only memory (ROM) **204**, random access memory (RAM) **206**, expansion ram **208**, input/output

(I/O) circuitry **210**, and display **212**. PDA **200** also may optionally include a mass storage unit **214**, such as a disk drive unit or a non-volatile memory such as a flash memory and a real time clock **216**.

Processor **202** is preferably a commercially available single chip microprocessor and preferably a complex instruction set chip (CISC). Of course, other types of processors may be employed depending on the implementation. In this example, processor **202** is coupled to ROM **204** by a data bus **218**, a control bus **220**, and an address bus **222**. ROM **204** contains the basic operating system for PDA **200** in these examples. Processor **202** is also connected to RAM by data bus **218**, control bus **220**, and address bus **222** to permit the use of RAM **206** as a scratch pad or storage for data. RAM **208** is optionally coupled to RAM **206** for use by processor **202**. Processor **202** also is coupled to I/O circuitry **210** by data bus **218**, control bus **220**, and address bus **222** to permit data transfers with peripheral devices.

I/O circuitry **210** typically includes the number of latches, registers, and direct memory access (DMA) controllers. The purpose of I/O circuitry **210** is to provide an interface between processor **202** and peripheral devices, such as display assembly **212** and mass storage unit **214**.

Display assembly **212** in PDA **200** is both an input and output device in these examples. Accordingly, display assembly **212** is connected to I/O circuitry **210** by a bi-directional data bus **218**. Operating as an output device, display assembly **212** receives data from I/O

circuitry **210** via data bus **218** and displays that data on a suitable screen. The screen for display assembly **212** is, in these examples, a liquid crystal display (LCD). The input device of display assembly **212** can be a thin, clear membrane covering the LCD display and which is sensitive to the position of a stylus, such as stylus **226** on its surface. Alternatively, the screens may be provided with an embedded radio frequency (RF) digitizer and an "active" RF stylus. Of course, other types of combinations of screen/tablet technologies may be employed.

Additionally, other types of user inputs may be used in conjunction with the present invention. While the processes are described with reference to the context of a pen system, other types of pointing devices may benefit from the processes of the present invention. These types of pointing devices include, for example, a mouse, a trackball, or a tablet to manipulate a pointer displayed on the screen.

A mass storage device, such as mass storage unit **214**, is generally desirable, but may be eliminated by providing a sufficient amount of RAM **206** and expansion RAM **208** to store user application programs and data. In such a case, RAM **206** and RAM **208** may be provided with a backup battery to prevent loss of data even when PDA **200** is turned off. It is generally desirable, however, to have an additional mechanism for long term storage, such as mass storage unit **214**. Mass storage unit **214** may take different forms, such as, for example, a miniature hard disk drive, or some other non-volatile memory, such as, for example, a flash memory, a battery backed RAM, or a

PC data card.

In operation, information is entered into PDA **200** by a user manipulating stylus **226** to "write" on the screen of display assembly **212**. Information concerning the location of stylus **226** is sent to processor **202** via I/O circuitry **210**. Typically, this information comprises cartesian coordinates of a pixel of the screen display assembly **212** over which the tip of stylus **226** is positioned. Processor **202** processes the data under the control of an operating system and possibly an application program stored in ROM **204** or in RAM **206** and RAM **208**. Data may be produced in response to this user input by processor **202**, which is then output on display **212**.

Additionally, expansion bus **228** is coupled to data bus **218**, control bus **220**, and address bus **222**. In this manner, expansion bus **228** may provide extra ports to couple devices, such as a modem, a display switch, a microphone and a speaker to processor **202**.

With reference now to the **Figures 3** and **4**, in particular, with reference to **Figure 3**, a pictorial representation of a data processing system is shown in which the present invention may be implemented in accordance with a preferred embodiment of the present invention. A personal computer **300** is depicted which includes a system unit **310**, a video display terminal **302**, a keyboard **304**, storage devices **308**, which may include floppy drives and other types of permanent and removable storage media, and mouse **306**. Additional input devices may be included with personal computer **300**. Personal

computer **300** can be implemented using any suitable computer, such as an IBM Aptiva™ computer, a product of International Business Machines Corporation, located in Armonk, New York. Although the depicted representation shows a personal computer, other embodiments of the present invention may be implemented in other types of data processing systems, such as network computers, Web based television set top boxes, Internet appliances, etc. Computer **300** also preferably includes a graphical user interface that may be implemented by means of systems software residing in computer readable media in operation within computer **300**.

With reference now to **Figure 4**, a block diagram illustrates a data processing system in which the present invention may be implemented. Data processing system **400** is an example of a computer, such as computer **300** in **Figure 3**, in which code or instructions implementing the processes of the present invention may be located. Data processing system **400** employs a peripheral component interconnect (PCI) local bus architecture. Although the depicted example employs a PCI bus, other bus architectures such as Micro Channel and Industry Standard Architecture (ISA) may be used. Processor **402** and main memory **404** are connected to PCI local bus **406** through PCI bridge **408**. PCI bridge **408** also may include an integrated memory controller and cache memory for processor **402**.

Additional connections to PCI local bus **406** may be made through direct component interconnection or through add-in boards. In the depicted example, local area network (LAN) adapter **410**, small computer system interface SCSI host bus adapter **412**, and expansion bus interface **414**

are connected to PCI local bus **406** by direct component connection. In contrast, audio adapter **416**, graphics adapter **418**, and audio/video adapter **419** are connected to PCI local bus **406** by add-in boards inserted into expansion slots. Expansion bus interface **414** provides a connection for a keyboard and mouse adapter **420**, modem **422**, and additional memory **424**. SCSI host bus adapter **412** provides a connection for hard disk drive **426**, tape drive **428**, and CD-ROM drive **430**. Typical PCI local bus implementations will support three or four PCI expansion slots or add-in connectors.

An operating system runs on processor **402** and is used to coordinate and provide control of various components within data processing system **400** in **Figure 4**. The operating system may be a commercially available operating system such as OS/2, which is available from International Business Machines Corporation. "OS/2" is a trademark of International Business Machines Corporation. An object oriented programming system such as Java may run in conjunction with the operating system and provides calls to the operating system from Java programs or applications executing on data processing system **400**. "Java" is a trademark of Sun Microsystems, Inc. Instructions for the operating system, the object-oriented operating system, and applications or programs are located on storage devices, such as hard disk drive **426**, and may be loaded into main memory **404** for execution by processor **402.**

Those of ordinary skill in the art will appreciate that the hardware in **Figure 4** may vary depending on the implementation. Other internal hardware or peripheral devices, such as flash ROM (or equivalent nonvolatile

memory) or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 4**. Also, the processes of the present invention may be applied to a multiprocessor data processing system.

The depicted example in **Figure 4** and above-described examples are not meant to imply architectural limitations. For example, data processing system **400** also may be a notebook computer or hand held computer. Data processing system **400** also may be a kiosk or a Web appliance.

Within a PDA, such as PDA **200** in **Figure 2** or a computer, such as computer **300** in **Figure 3**, the present invention provides a method, apparatus, and computer implemented instructions for maximizing the efficiency of available display space. The mechanism of the present invention may be used as an add on or hookup to existing window manager systems or function independently in the absence of a window manager. The mechanism of the present invention provides graphical widgets displayed on a screen. A graphical widget is a graphical input mechanism that can be resized to allow easier user input. Input may be received by the graphical widget in its reduced form, but is more difficult. These graphical widgets are displayed in a predefined size and layout in these examples. These graphical widgets are small in size and not typically suitable for user input, but when selected or tapped, a graphical widget will increase or grow in size to a preprogrammed percentage of the size of the screen and display a small "return" or "get back" graphical widget. This return widget is used to return

the graphical widget to its original size. Alternatively, instead of selecting a return widget, the user may reselect the graphical widget to cause the graphical widget to be resized to the original size.

Also, instead of increasing the size of the widget to preprogrammed percentage of the screen, the widget may be increased in size to a selected size and layout. When in its expanded form, the graphical widget is of a size that allows the user to input data using a stylus. Further, the size may be of one that allows the user to be able to see text being entered. When the return widget is selected, the graphical widget is returned to its original size and layout. This return widget may be a graphical object, such as, for example, a small button displayed in association with the graphical widget. Otherwise, the processes of the graphical widget provide behavior as normally found in a typical window or other field for data entry.

For example, a user of a PDA desires to fill in a name and number in a contact list. The user may tap a name test field, which is a graphical widget, with a stylus. In response, the graphical widget will increase in size such that the user can more easily enter the name. When the user is finished, the user may select the return widget and have the name text field return to its original size and layout. In this manner, many fields for input may be placed on small screens, but still allow a user to easily interact with these graphical widgets. This mechanism allows a number of different input fields and controls to be displayed on a screen to allow a user to select from those input fields and controls without having to diverse multiple windows. Alternatively, the

number of windows needing to be used may be reduced.

With reference now to **Figures 5A** and **5B**, diagrams illustrating an example of a graphical widget are depicted in accordance with a preferred embodiment of the present invention. In **Figure 5A**, display **500** includes small text field **502** and small text field **504**. Additionally, display **500** also includes a radio button **506** and a radio button **508**. In these examples, small text field **502** and small text field **504** are graphical widgets, which may be resized to allow for easier user input through pointer **510**.

By selecting or tapping small text field **504** using pointer **510**, small text field **504** expands to form text field **512** as shown in **Figure 5B**. Text field **512** allows for a user to more easily input data. Text field **512** may be reduced back to small text field **504** by selecting return widget **514** using pointer **510**. Alternatively, a selection of text field **512** may cause a return to the display of small text field **504** depending on the implementation. In the depicted examples, text could be entered by user into text field **504**, but the size of text field **504** makes such entry difficult for a user. By having text field **504** "grow" or "snap" to the size for text field **512**, a user is more easily able to enter data. Selection of small text field **504** results in a focus causing small text field to snap or grow on the screen to a "preferred" size as illustrated by text field **512**. The snap or growth may be in an animated fashion such that the use can easily track the field.

With reference now to **Figures 6A-6C**, diagrams

illustrating a graphical widget in the form of controls, are depicted in accordance with a preferred embodiment of the present invention. In **Figure 6A**, display **600** includes a display control **602**, and audio control **604**, and a selection field **606**. In this example, display control **602**, and audio control **604** are graphical widgets in accordance with a preferred embodiment of the present invention. Selection of one of these graphical widgets, such as display control **602** using pointer **608** results in display **602** growing in size to present display control **610** in **Figure 6B** in which a user may make various selections. For example, the user may select window button **612** or screen button **614** to adjust display **600**. Additionally, the display size may be adjusted using slider **616** along scroll bar **618**. Another selection of display control **610** results in the graphical widget returning to its original size as illustrated by display control **602** in **Figure 6A**. Similarly, selection of audio control **604** in **Figure 6A** results in audio control **620** being displayed in **Figure 6C**. In this example, the audio may be set to "stereo" by selection of button **622** or to "mono" by selection of button **624**. The volume may be adjusted by manipulating slider **626** in scroll bar **628** using pointer **608**.

In these examples, display control **610** and audio control **620** are enlarged versions of display control **602** and audio control **604** in which the controls are increased in size by some selected percentage. Although the user could manipulate display control **602** or audio control **604** in its reduced size, the resized versions, display

control **610** and audio control **620**, allow for easier manipulation by a user when display space is limited. This proportional change allows a user to easily track control as it changes size. The size of display control **610** and audio control **620** are selected such that a user may more easily manipulate the controls.

With reference now to **Figure 7**, a flowchart of a process for handling input to a graphical widget is depicted in accordance with a preferred embodiment of the present invention. These processes may be implemented as an add on to a window managing system. Alternatively, the processes may be implemented in a single unified window manager in an operating system.

The process begins by receiving user input (step **700**). Thereafter, a determination is made as to whether the user input is a focus event (step **702**). If the user input is not a focus event, the input is processed (step **704**) with the process then returning to step **700**. Otherwise, if the user input is a focus event, a preferred size is identified for the graphical widget (step **706**). In the depicted examples, this preferred size is some percentage of the original size of the graphical widget. The exact percentage change is determined based on the available display area and the size needed for a user to easily input data into the graphical widget. After the preferred size is identified, the graphical widget is resized (step **708**) and the screen is painted with the resized graphical widget (step **710**). Of course, the repainting may include an animation to show the "growth" or "snapping" of the graphical widget from the original size to the new size.

Thereafter, the process receives user input to the display(step **712**). Upon receiving user input, a determination is made as to whether the input is a size trigger event that returns the graphical widget to the original size (step **714**). If the user input is not one to return the graphical widget to the original size, the user input is processed (step **716**) with the process then returning to step **712**. Otherwise, the graphical widget is resized to the original size (step **718**). Then, the screen on the display is repainted with the resized graphical widget (step **720**) with the process then returning to step **700** as described above.

In the depicted examples, in resizing the widget to a preferred size, the resize or return widget may be optionally displayed in association with widget to return the size trigger event. Alternatively, the size trigger event may be caused by a reselection of the graphical widget by the user.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media such a floppy disc, a hard disk drive, a RAM, and CD-ROMs and transmission-type media such as digital and analog communications links.

The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. For example, the processes of the present invention may be applied to provide graphical widgets for use in other types of data processing systems, such as, for example, a digital versatile disk (DVD) player system in which menus are displayed to a user on a screen, such as a television. In such a system, various fields may be presented using graphical widgets in which a pointer controlled by a remote control for the DVD player may be used to input and select information for use in controlling the DVD player. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.